

Chemical Controllers of Plant Life

A diagnostic overview of Plant Growth Regulators (PGRs) and their physiological effects.

Data compiled from Charles Darwin to modern biochemical analysis.

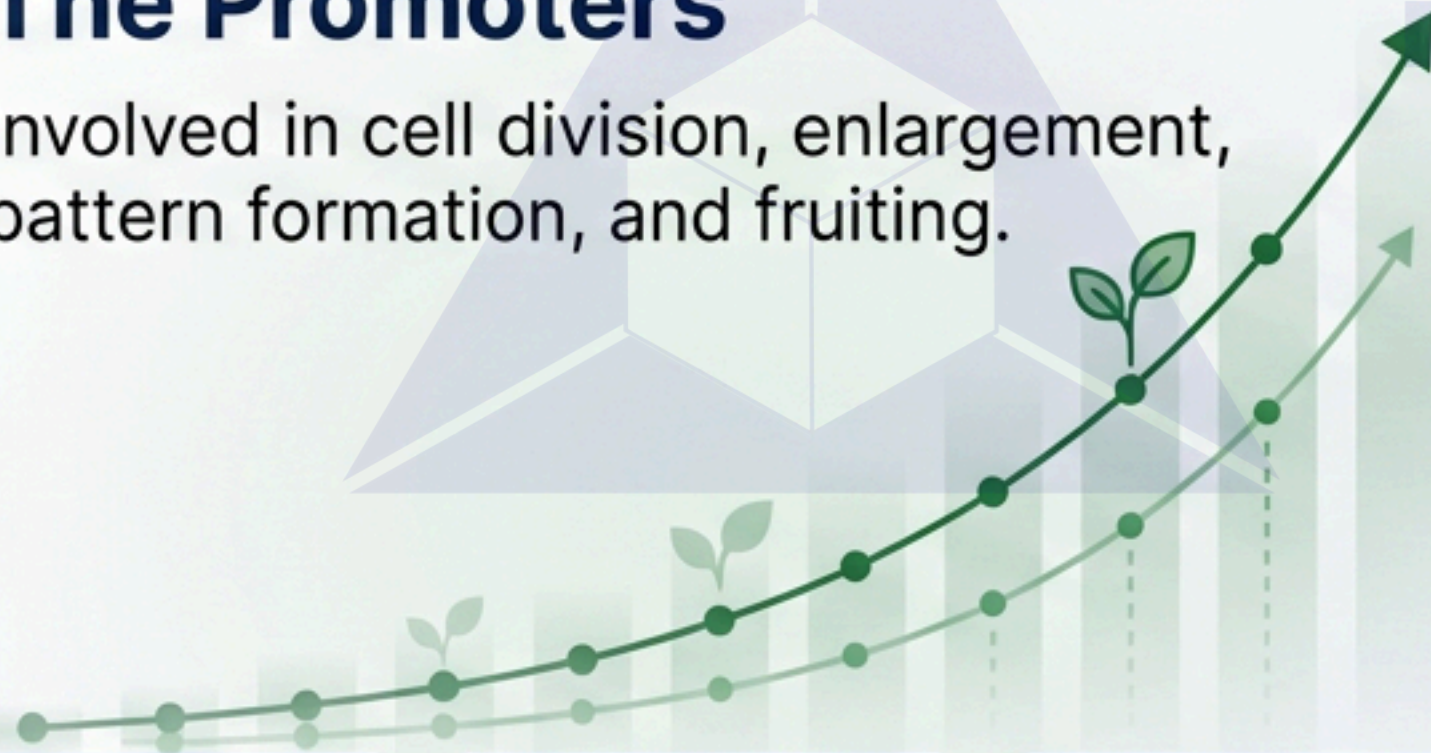


Defining Phytohormones

Plant Growth Regulators (PGRs) are small, simple molecules of diverse chemical composition that dictate plant development.

The Promoters

Involved in cell division, enlargement, pattern formation, and fruiting.



Auxins
(Indole
compounds)

Gibberellins
(Terpenes)

Cytokinins
(Adenine
derivatives)

The Inhibitors & Responders

Involved in wound response, stress tolerance, dormancy, and abscission.



Abscissic Acid
(Carotenoid
derivatives)

Ethylene
(Gases - largely
inhibitory)

Auxins: The Apex Controllers

IAA / IBA (Natural)

NAA / 2,4-D (Synthetic)

Discovery Note:

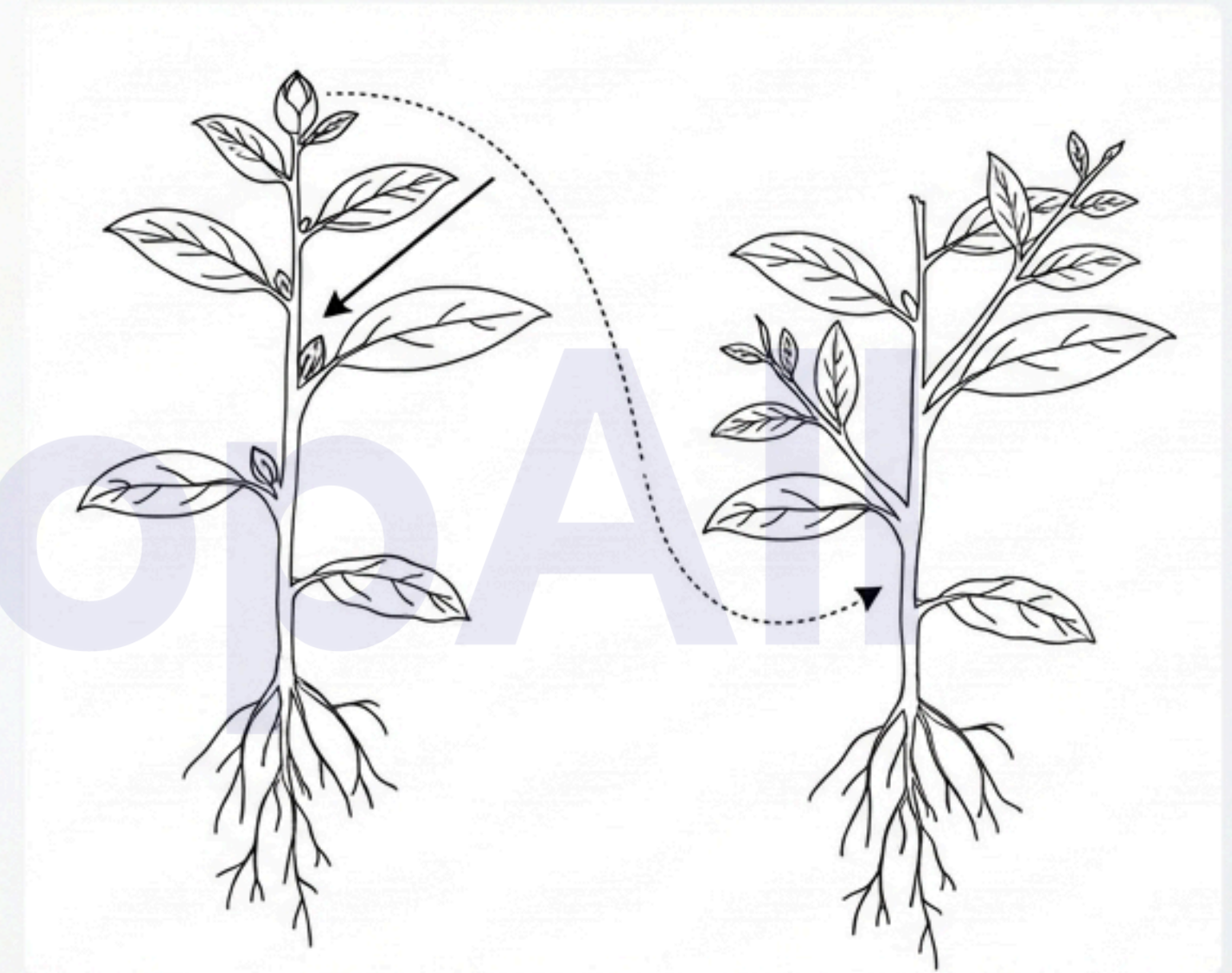
First observed by Charles & Francis Darwin in canary grass coleoptiles (phototropism).

Later isolated by F.W. Went from oat seedlings. Originally isolated from human urine.

Takeaway Panel

Widely used in agriculture to initiate rooting in stem cuttings, induce parthenocarpy (seedless tomatoes), and selectively kill dicot weeds (using 2,4-D) to create weed-free lawns.

Mechanism: Apical Dominance



This decapitation principle is heavily applied in tea plantations and hedge-making.



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Gibberellins: The Axis Elongators

GA1, GA2, GA3 (Over 100 reported, all acidic)

Discovery Note:

Discovered via the 'bakanae' (foolish seedling) disease in rice. In 1926, E. Kurosawa found it was caused by the fungal pathogen *Gibberella fujikuroi*.

Takeaway: GAs delay senescence, allowing fruits like apples to remain on trees longer, extending the market period.



Spraying sugarcane increases stem length, boosting yield by up to 20 tonnes per acre.



Bolting



Internode elongation just prior to flowering.

Cytokinins: The Division Promoters

Specifically control cytokinesis. Synthesised in regions of rapid cell division (root apices, developing shoot buds).

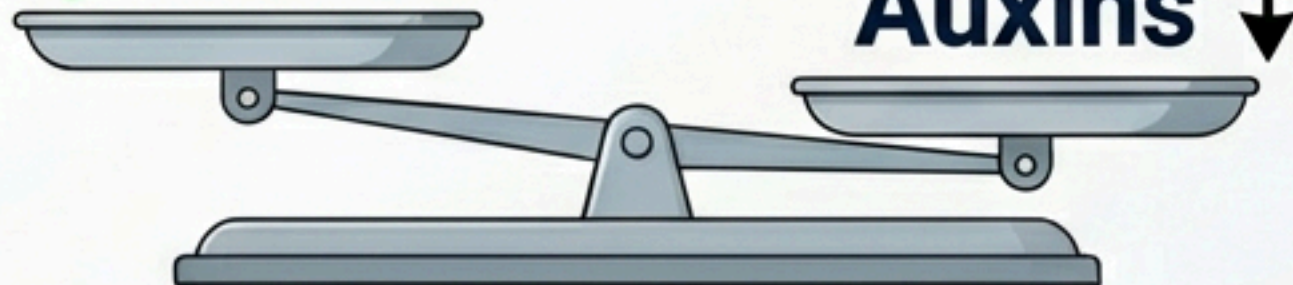
Synthetic: Kinetin

Discovered by F. Skoog & Miller (1955) from autoclaved herring sperm DNA. Does not occur naturally in plants.

Natural: Zeatin

Later isolated from corn-kernels and coconut milk.

↑ **Cytokinins**



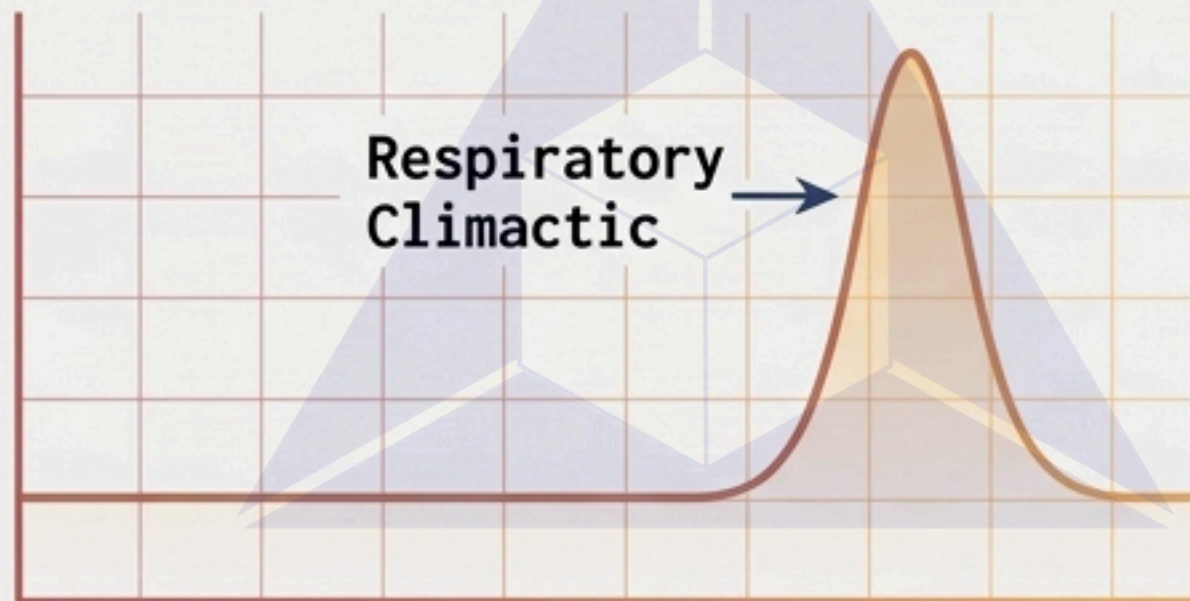
Auxins ↓

Cytokinins actively overcome apical dominance (acting antagonistically to Auxins). They also promote nutrient mobilisation, which delays leaf senescence.

Ethylene (The Ripening Gas)

C_2H_4 (Volatile Gas)

Discovery: Confirmed by H.H. Cousins (1910) when volatile substances from oranges ripened stored bananas.

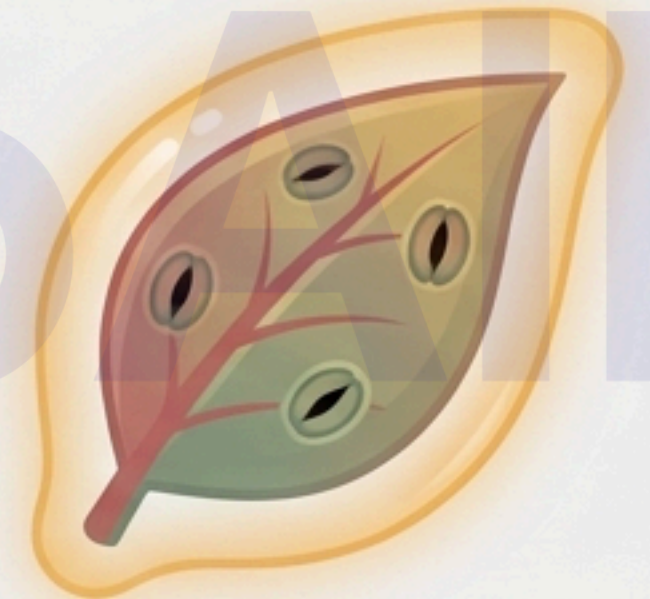


- Promotes senescence and abscission.
- Breaks seed dormancy.
- Highly used in agriculture (Ethephon) to hasten tomato/apple ripening and synchronize pineapple flowering.

Absciscic Acid (The Stress Hormone)

ABA (Carotenoid derivative)

Discovery: Independently discovered in the 1960s as inhibitor-B, abscission II, and dormin before being proven chemically identical.



- General plant metabolism inhibitor.
- Stimulates stomatal closure during severe stress.
- Induces seed dormancy to withstand desiccation (acts as a direct antagonist to GAs).

The PGR Diagnostic Matrix

Life Phase	Auxins	Gibberellins	Cytokinins	Ethylene	ABA
Seed Germination	•	+	•	•	-
Apical Dominance	+	•	-	•	•
Fruit Ripening	•	•	•	+++	•
Senescence & Abscission	•	-	-	+	+

Intrinsic Control Networks

PGRs rarely act alone. Every phase of plant development is governed by synergistic and antagonistic interactions between these hormones, working in tandem with genomic control and extrinsic factors like light and temperature.



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